

1. **DESCRIPTION:** Students will demonstrate an understanding of the basic concepts of mathematics and physics relating to galaxies.

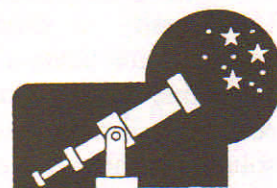
A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:** Each team member is permitted to bring either a laptop computer or one 3-ring binder (any size) containing information in any form from any source. The materials must be 3-hole punched and inserted into the rings (notebook sleeves are allowable). Each team member is permitted to bring a programmable calculator. No Internet access is allowed.
3. **THE COMPETITION:** Using information which may include H-R diagrams, spectra, light curves, motions, distance equations and relationships, stellar magnitudes and classification, multi-wavelength images, charts, graphs, and animations, participants will be asked to complete activities which include the following:
 - a. Use all available information to determine answers relating to **quasars, AGNs, galaxy clusters and groups of galaxies**, including star formation, massive and **supermassive** black holes, galactic structure, globular clusters, Type Ia & Type II supernovae, eclipsing binaries and X-ray binaries.
 - b. Use all available information, including Kepler's laws, to determine answers relating to the orbital motions of binaries; cosmological distance equations and the period-luminosity relationship (Cepheids and RR Lyrae) to answer questions related to characteristics and distances of galaxies, Hubble's Law **or spectra** to answer questions about Hubble's constant and the recessional velocities and distances of galaxies.
 - c. Students will be asked to identify, be knowledgeable about, and answer questions relating to the content areas outlined above for the following Deep Sky Objects (DSOs): *Epsilon Aurigae, NGC 6240, 3C321, Cen A, Stephan's Quintet, MACSJ0717.5+3745, Bullet Cluster (1E 0657-56), Perseus A (NGC 1275), SN 2006gy, SN 1996cr, NGC 4603, NGC 7771, NGC 2623, JKCS041, NGC 1068, H2356-309 *Epsilon Aurigae is part of a nationwide observing campaign for 2010 and 2011, and will be included in the Astronomy Event for 2011.
 - d. Competition may include one or more stations. Examples include sequencing images of galaxies by **distance or activity**; placing images of different types of objects in the correct locations within galaxies; matching images of light curves with the appropriate objects; using charts, data tables and/or graphs to determine distances and calculate Hubble's constant; using graphing calculators to plot observational data and calculate periodicity or distance.

4. **SCORING:** All questions will have been assigned a predetermined number of points. The highest score wins. Selected questions having differentiated weights will be used to break ties.

Recommended Resources: All reference and training resources including the **Astronomy CD Rev. 2011** are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>



National Science Education Standards: Science as Inquiry, Content Standard A: Use Technology and Mathematics to Improve Investigations and Communications; Formulate and Revise Scientific Explanation and Models using Logic and Evidence; Earth and Space Science, Content Standard D: The Origin and Evolution of the Universe (Grades 9-12).

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